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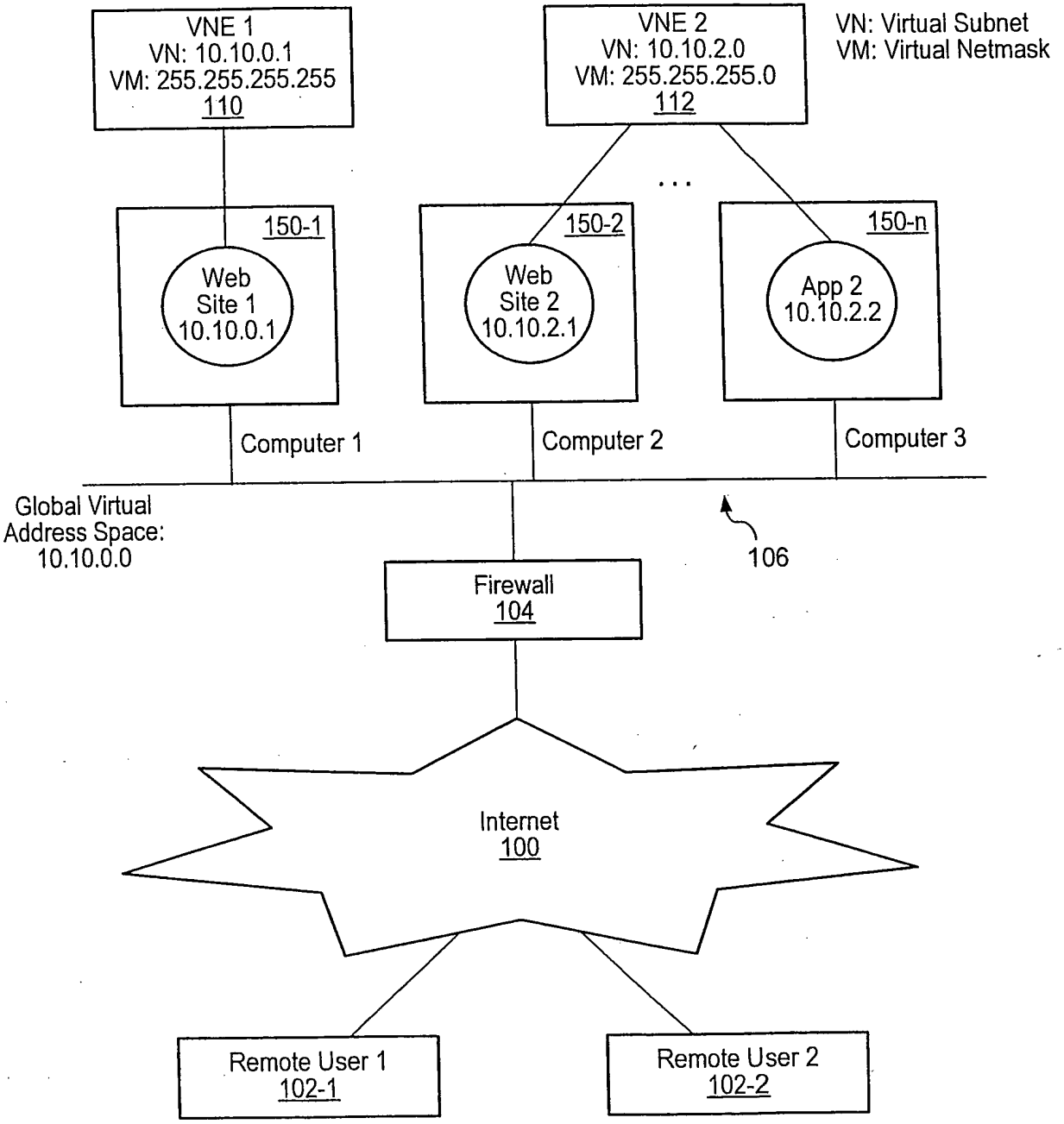
PATENT & TRADEMARK OFFICE



The above diagram illustrates the virtual network environments. Virtual Network Environment 1 contains one application WEB SITE 1, is defined by the Virtual Network Address 10.10.0.1 resides solely on computer 1. Virtual Network Environment 2 contains two applications, WEB SITE 2 and APP 2, and spans two computers, Computer 2 and Computer 3. The virtual network of VNE 2 is 10.10.2.0.

Fig. 1

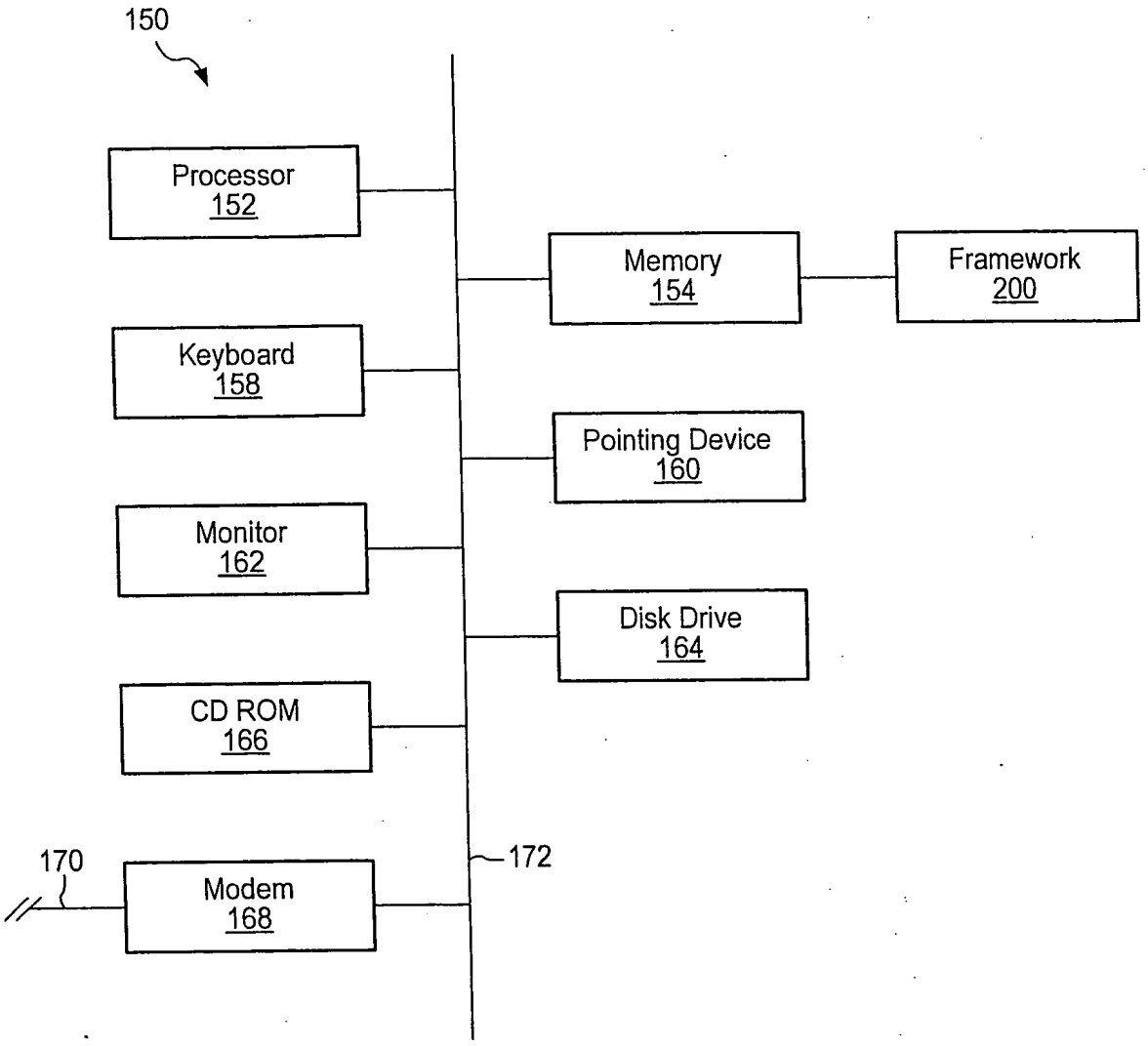
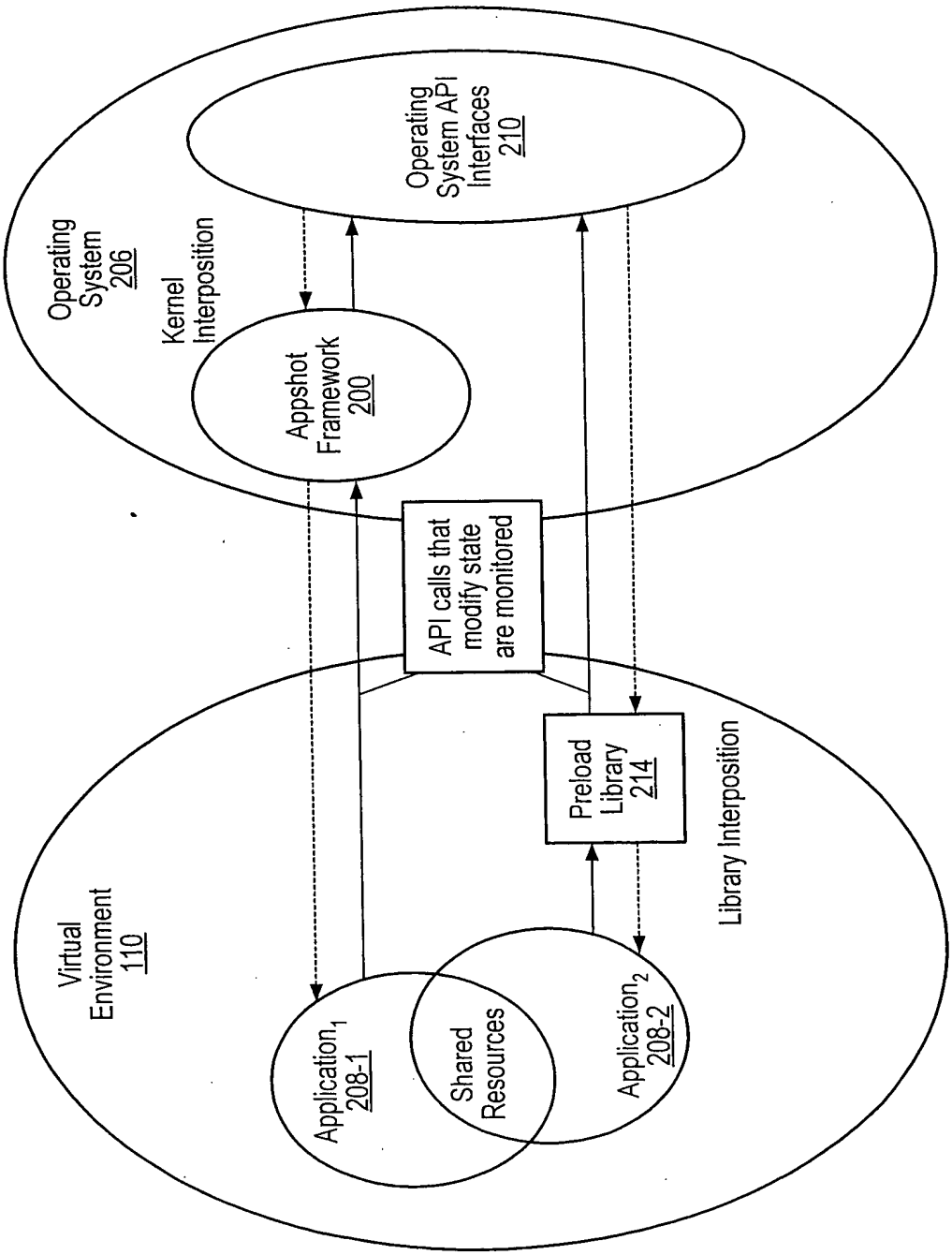
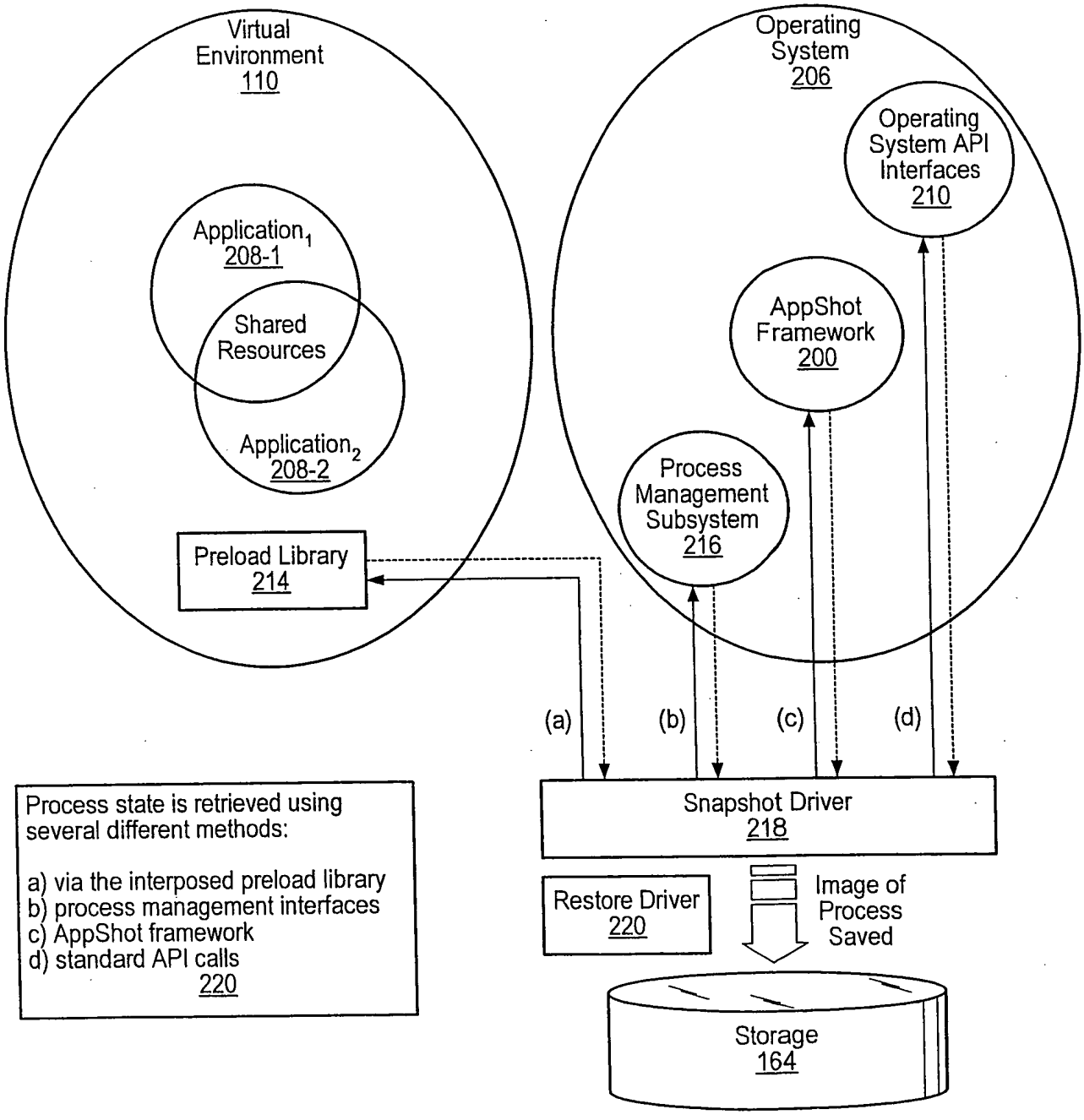

150
Processor
152
Memory
154
Framework
200
Keyboard
158
Pointing Device
160
Monitor
162
Disk Drive
164
CD ROM
166
170
Modem
168
172

Fig. 2



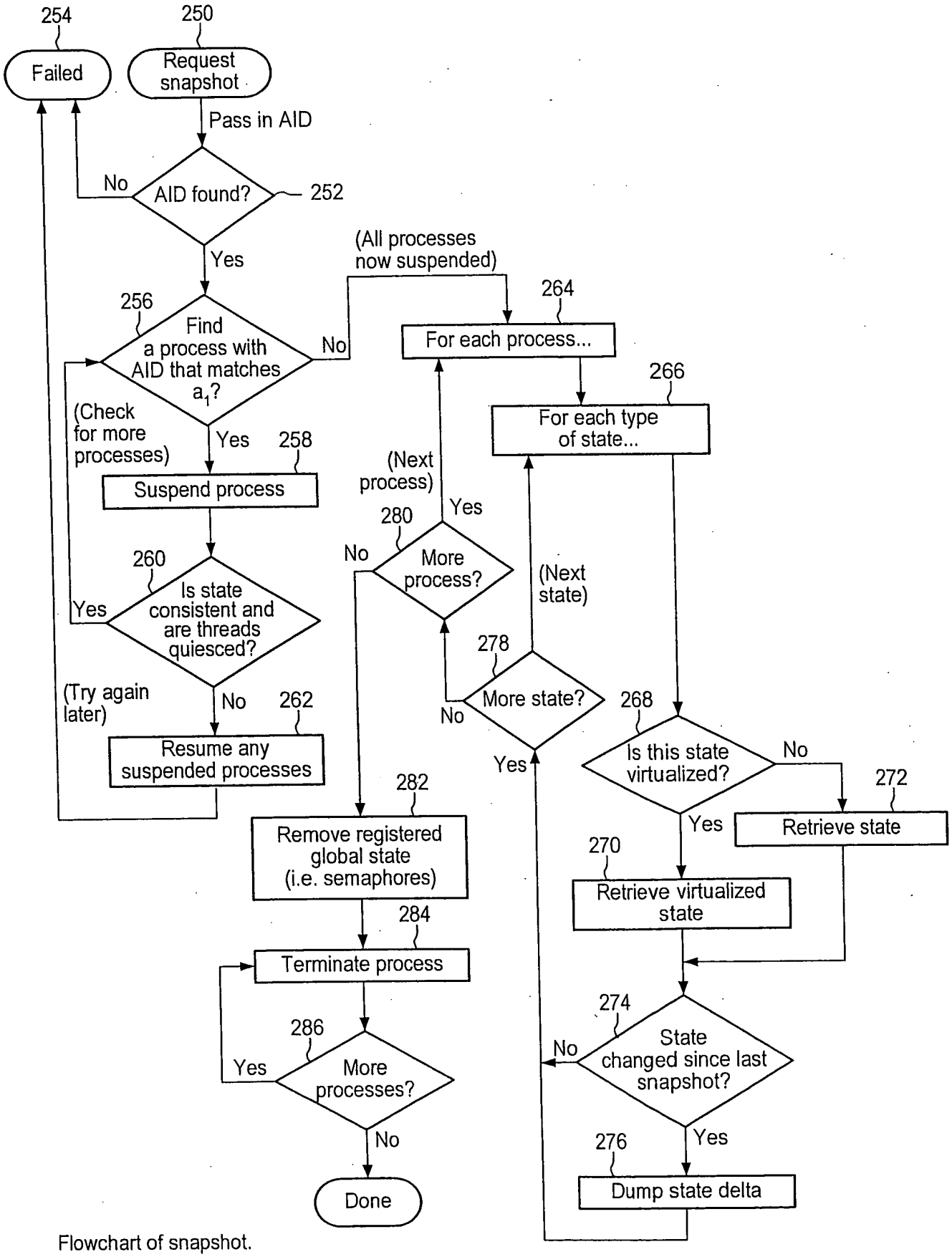
Tracking application state via library and kernel interposition.

Fig. 3



Capture of an application's run-time state.

Fig. 4



Flowchart of snapshot.

Fig. 5

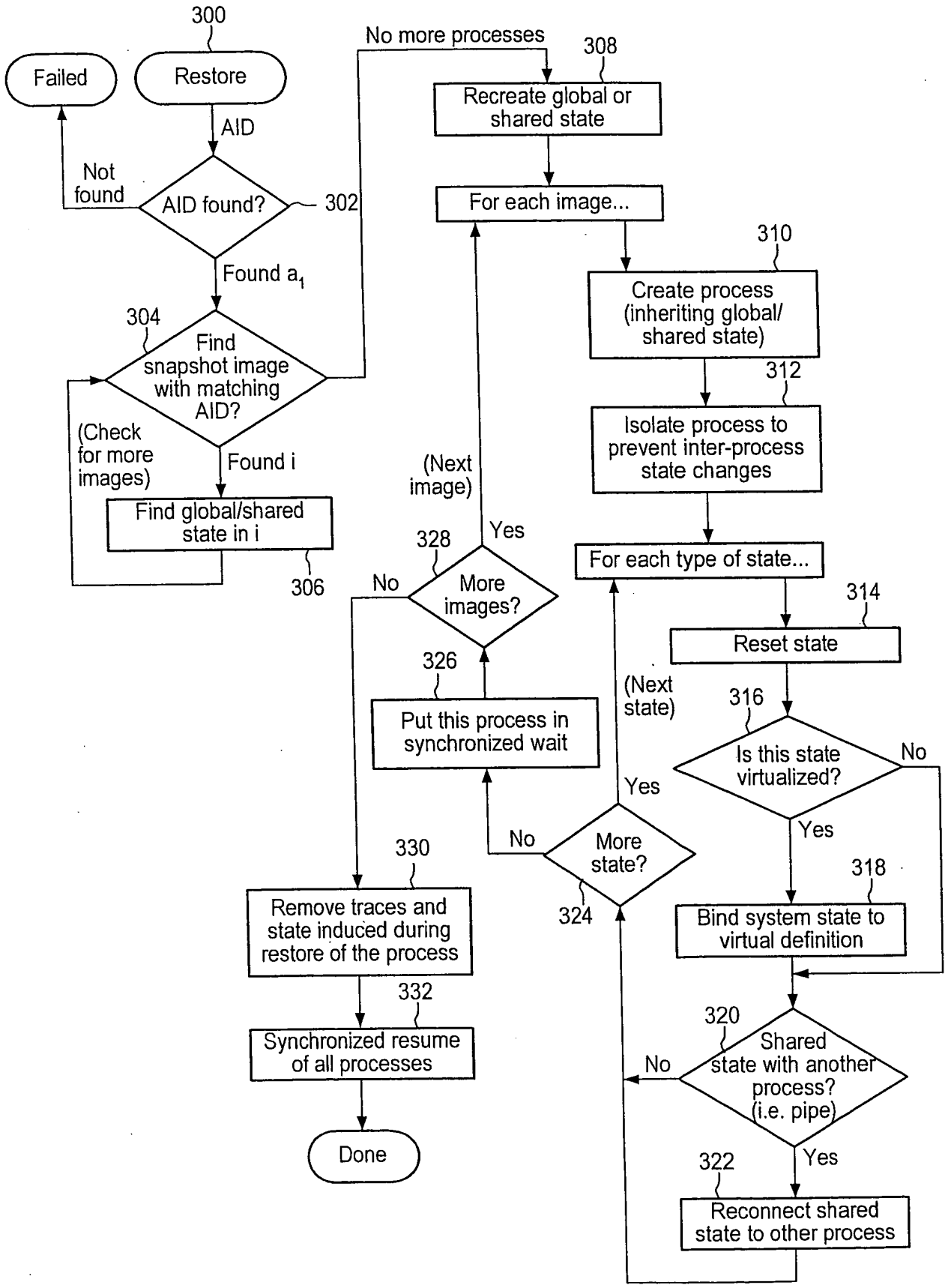

300
Restore
Failed
AID
Not found
AID found?
302
Found a_1
304
Find snapshot image with matching AID?
(Check for more images)
Found i
Find global/shared state in i
306
No more processes
308
Recreate global or shared state
For each image...
310
Create process (inheriting global/ shared state)
312
Isolate process to prevent inter-process state changes
For each type of state...
314
Reset state
316
Is this state virtualized?
No
Yes
318
Bind system state to virtual definition
320
Shared state with another process? (i.e. pipe)
No
Yes
322
Reconnect shared state to other process
(Next state)
Yes
No
More state?
324
(Next image)
328
More images?
Yes
No
326
Put this process in synchronized wait
330
Remove traces and state induced during restore of the process
332
Synchronized resume of all processes
Done

Fig. 6

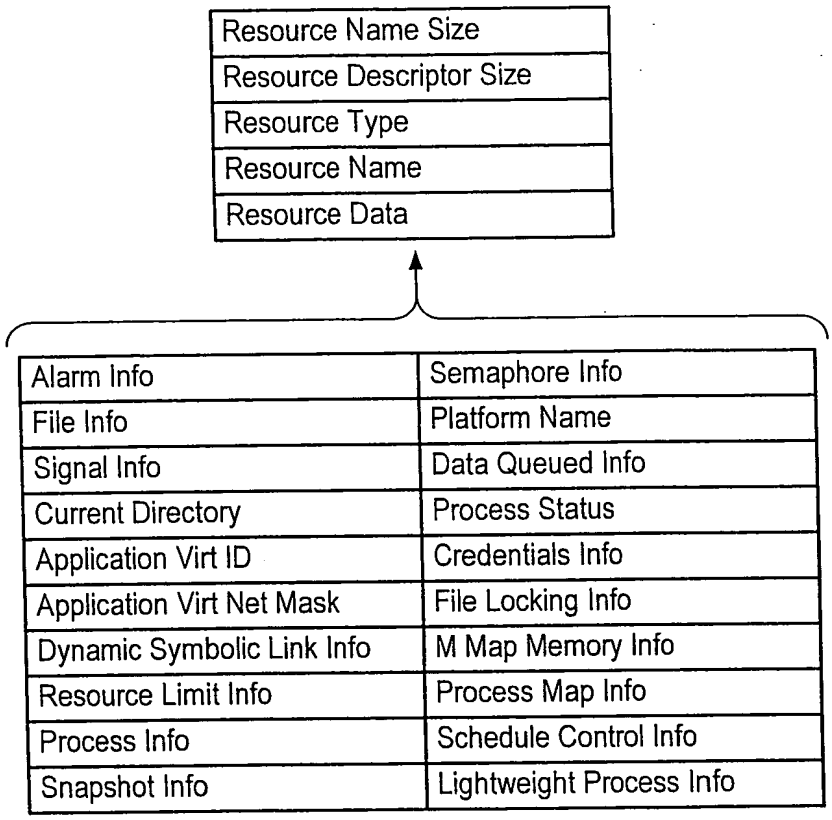

Resource Name Size
Resource Descriptor Size
Resource Type
Resource Name
Resource Data
Alarm Info
File Info
Signal Info
Current Directory
Application Virt ID
Application Virt Net Mask
Dynamic Symbolic Link Info
Resource Limit Info
Process Info
Snapshot Info
Semaphore Info
Platform Name
Data Queued Info
Process Status
Credentials Info
File Locking Info
M Map Memory Info
Process Map Info
Schedule Control Info
Lightweight Process Info

Fig. 7

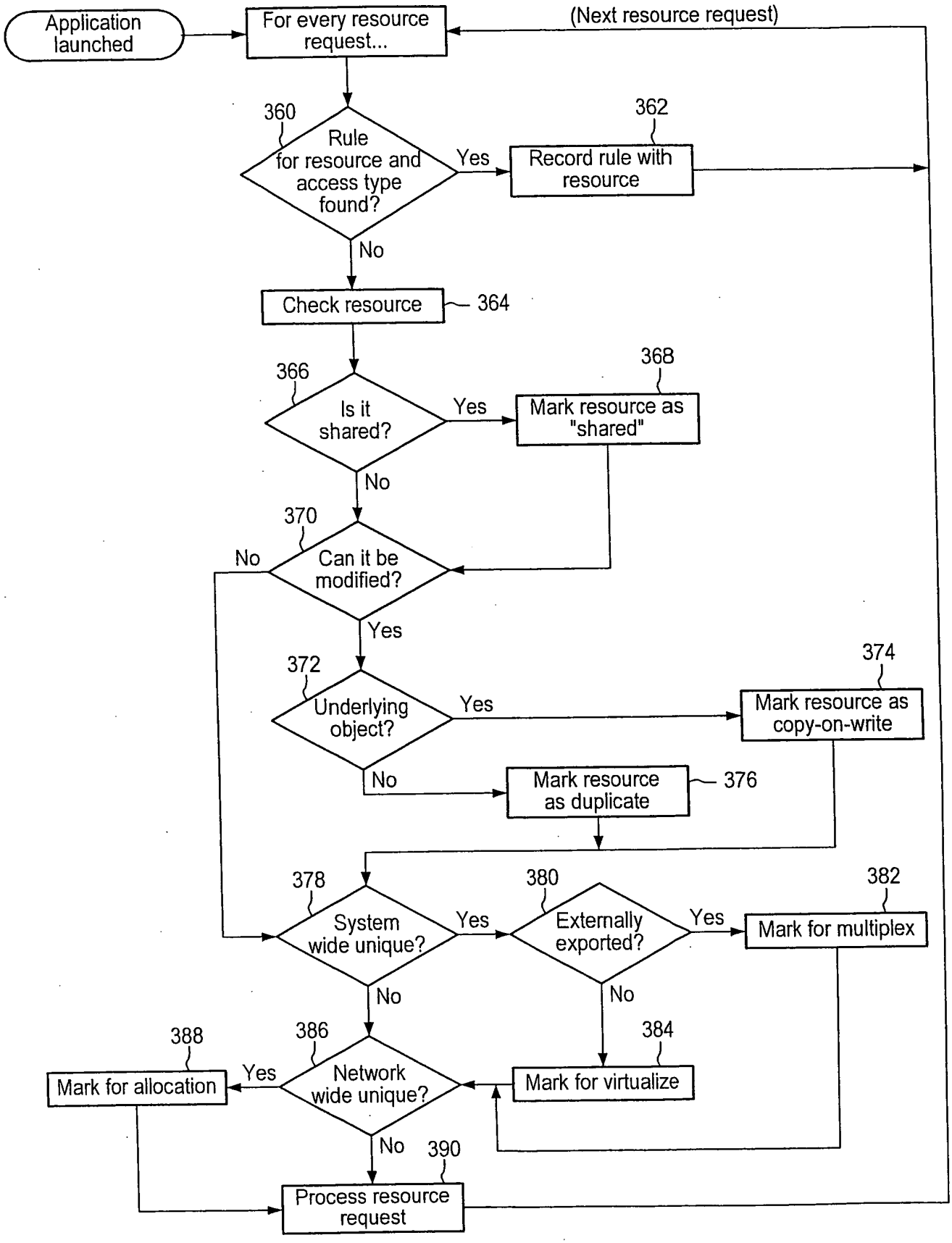

Application launched
For every resource request...
(Next resource request)
360
Rule for resource and access type found?
Yes
362
Record rule with resource
No
Check resource
364
366
Is it shared?
Yes
368
Mark resource as "shared"
No
370
No
Can it be modified?
Yes
372
Underlying object?
Yes
374
Mark resource as copy-on-write
No
Mark resource as duplicate
376
378
System wide unique?
Yes
380
Externally exported?
Yes
382
Mark for multiplex
No
No
388
386
Mark for allocation
Yes
Network wide unique?
384
Mark for virtualize
No
390
Process resource request

Fig. 8

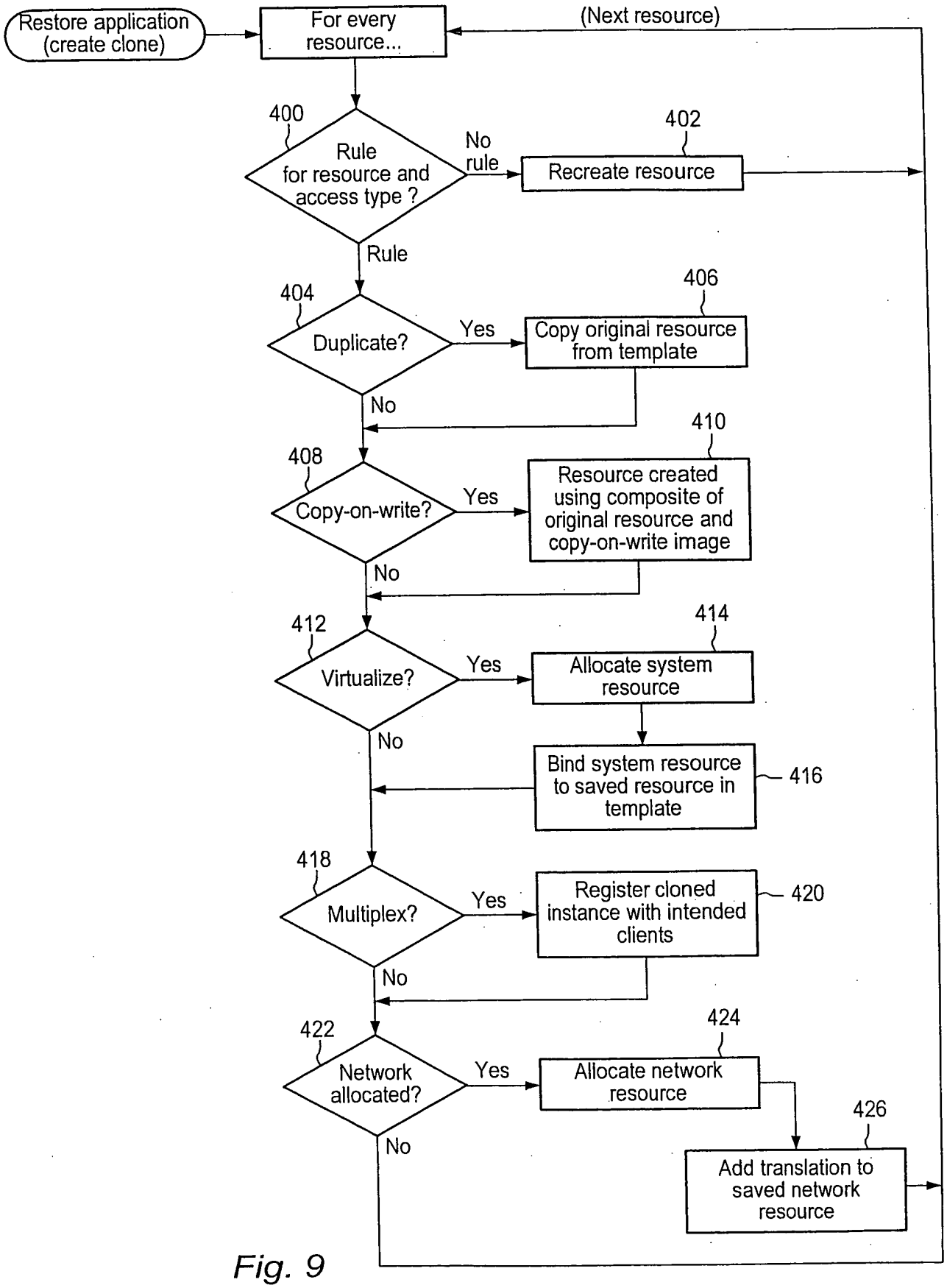
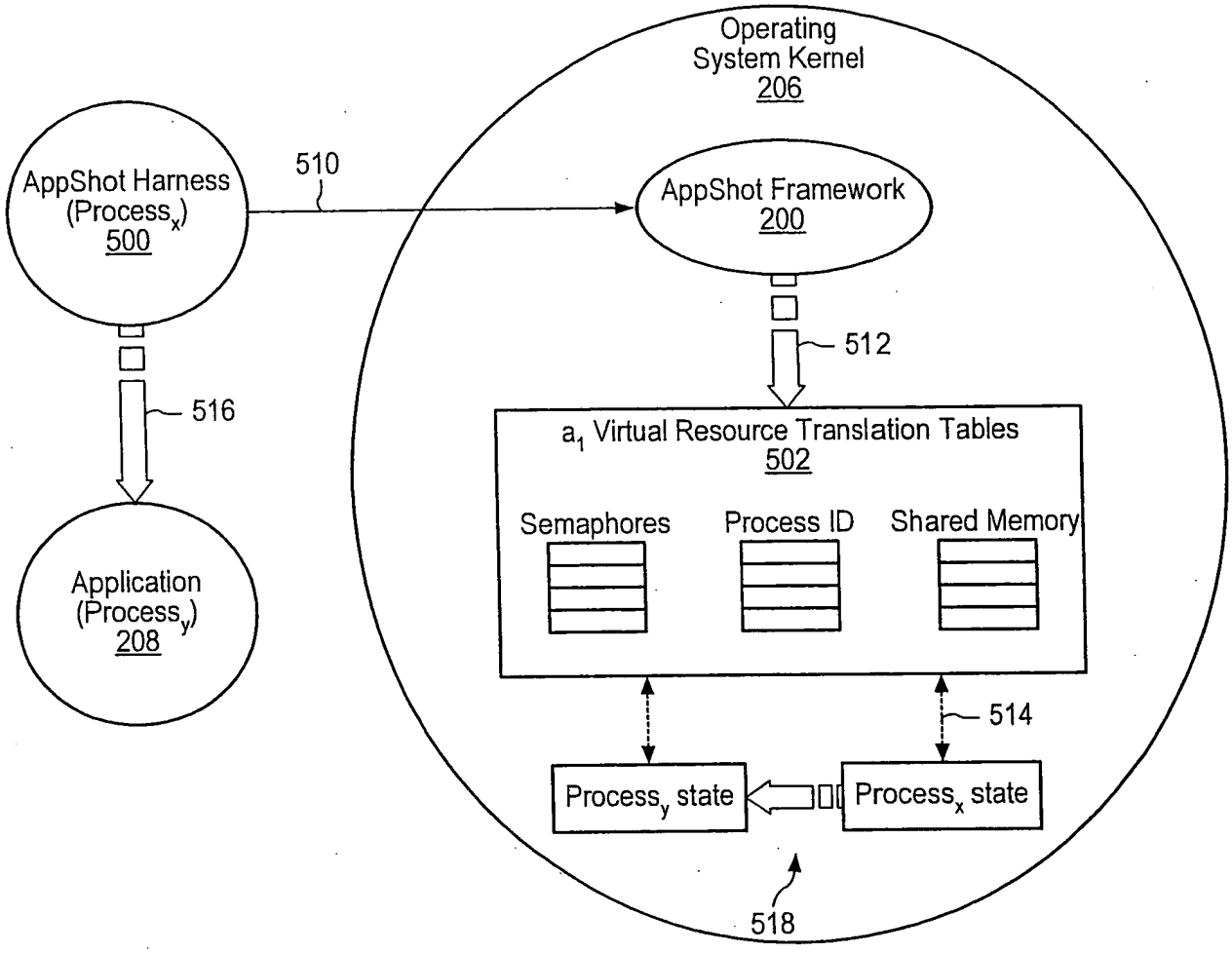
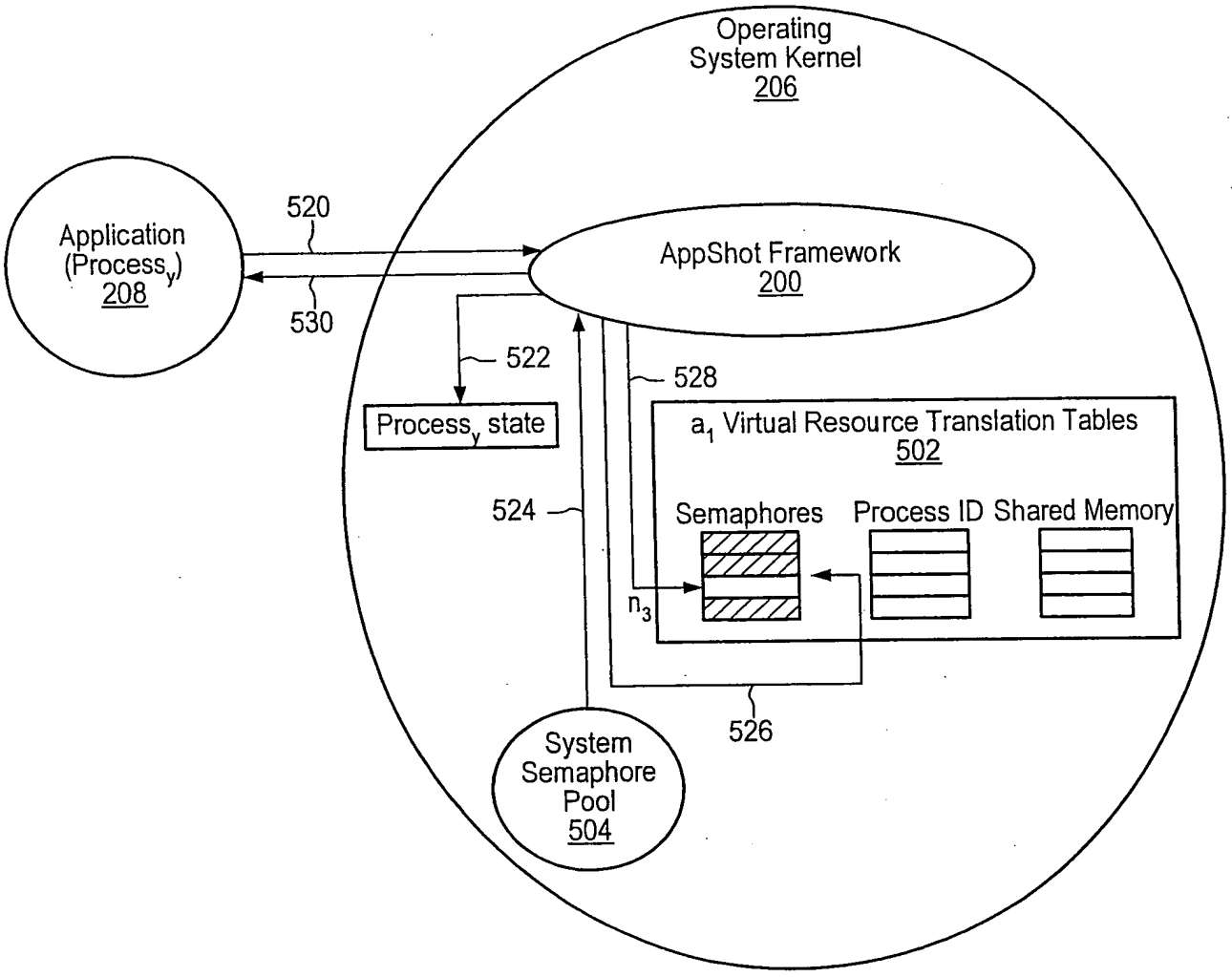

Restore application (create clone)
For every resource...
(Next resource)
400
Rule for resource and access type ?
No rule
402
Recreate resource
Rule
404
Duplicate?
Yes
406
Copy original resource from template
No
408
Copy-on-write?
Yes
410
Resource created using composite of original resource and copy-on-write image
No
412
Virtualize?
Yes
414
Allocate system resource
No
Bind system resource to saved resource in template
416
418
Multiplex?
Yes
Register cloned instance with intended clients
420
No
422
Network allocated?
Yes
424
Allocate network resource
426
No
Add translation to saved network resource

Fig. 9



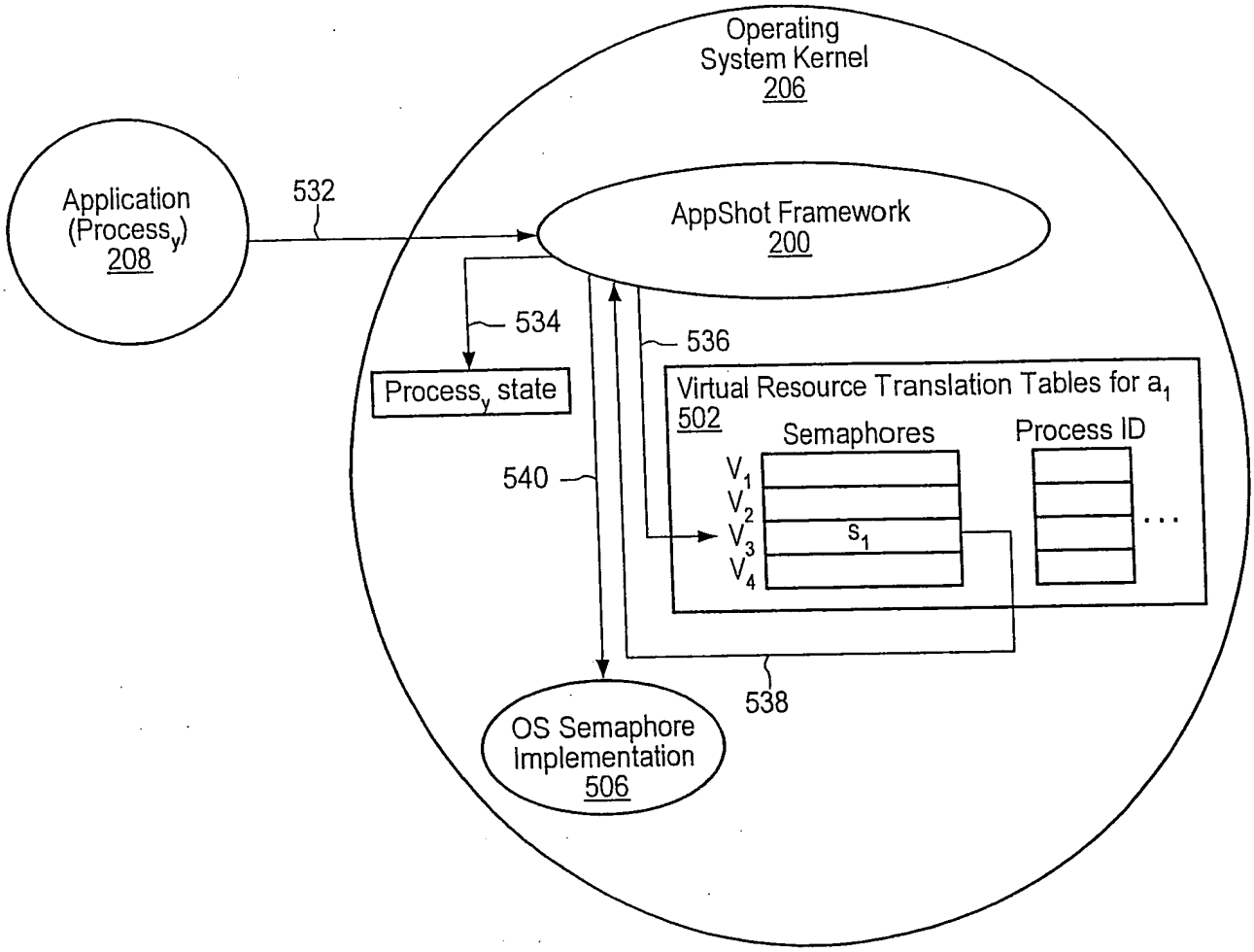
Registration of an application using virtual resource ID's

Fig. 10



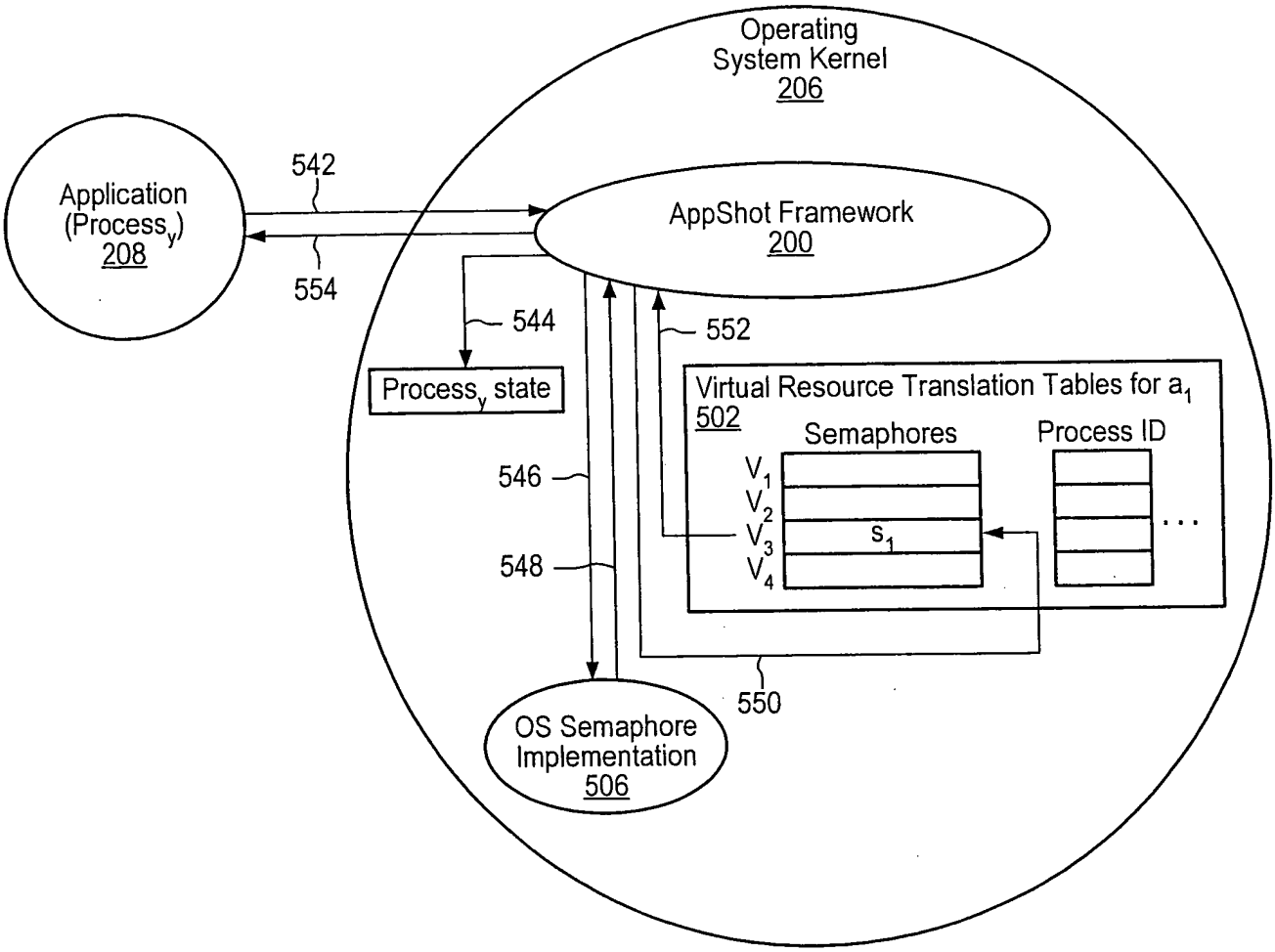
Allocation of a virtual resource (i.e. semaphore)

Fig. 11



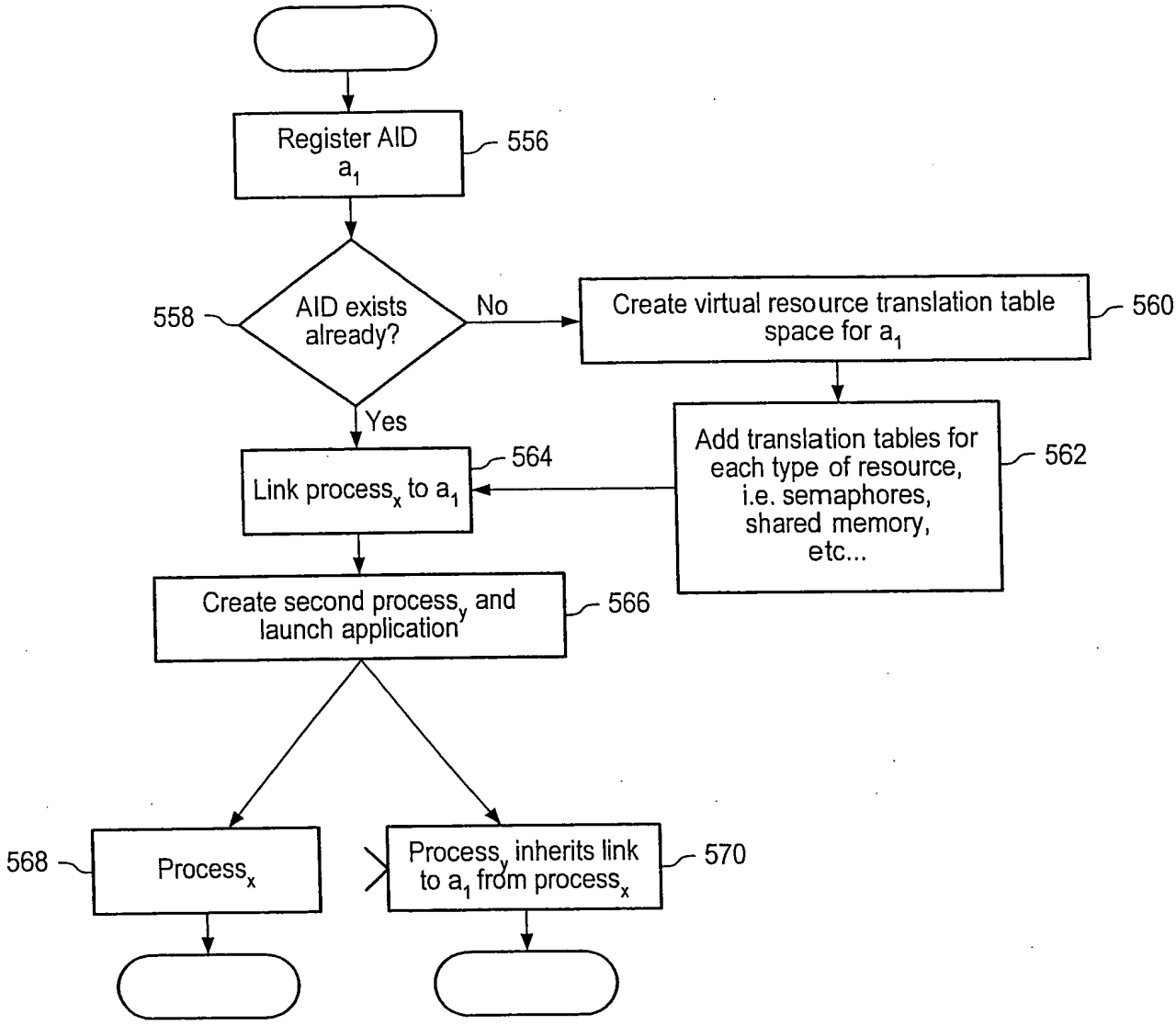
Translation of a virtual resource (i.e. semaphore), virtual to system

Fig. 12



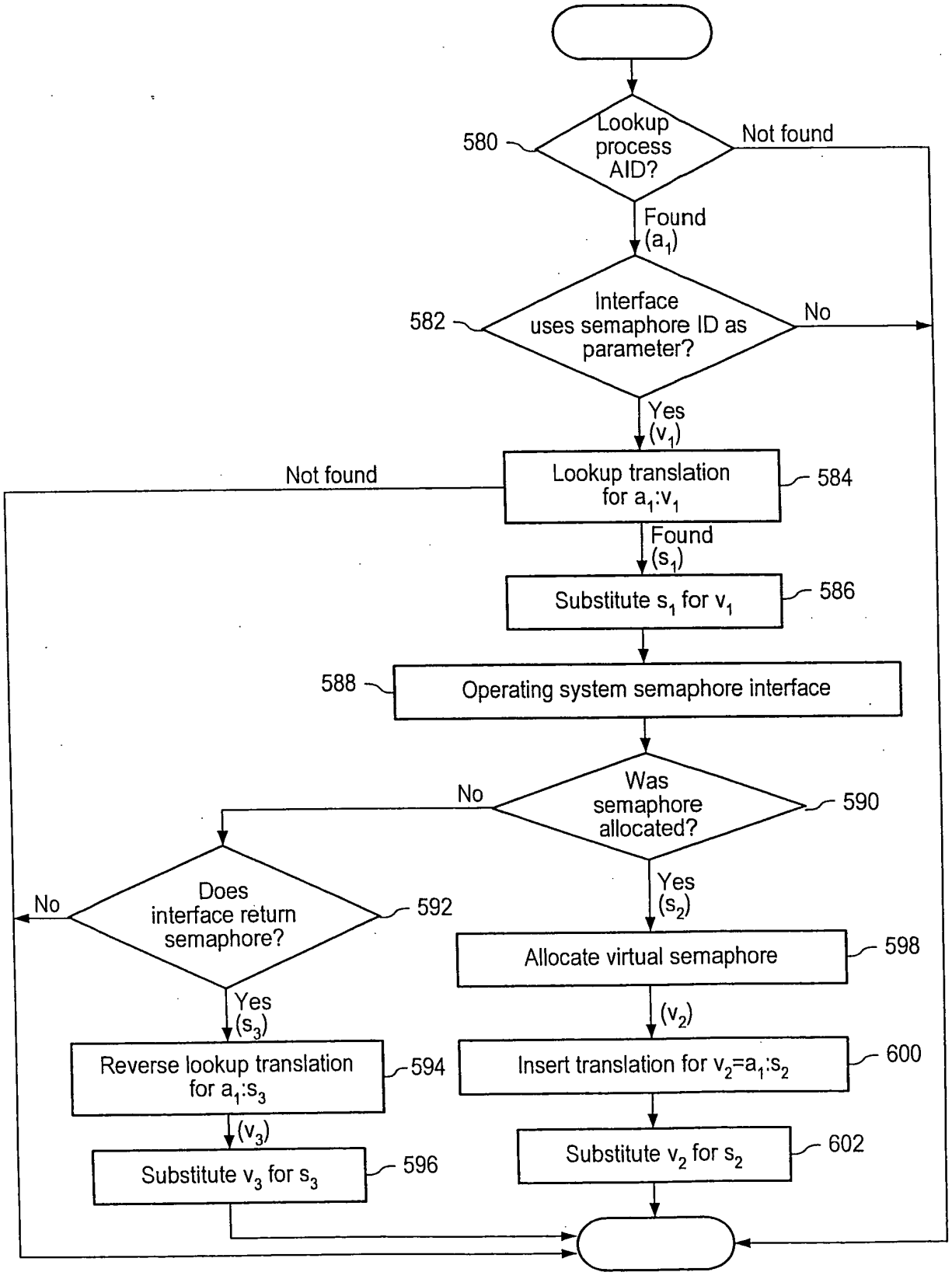
Reverse Translation of a virtual resource (i.e. semaphore), system to virtual

Fig. 13



Flowchart describing creation of virtual translation tables

Fig. 14



Flowchart depicting translation of a virtual resource (i.e. semaphore)

Fig. 15

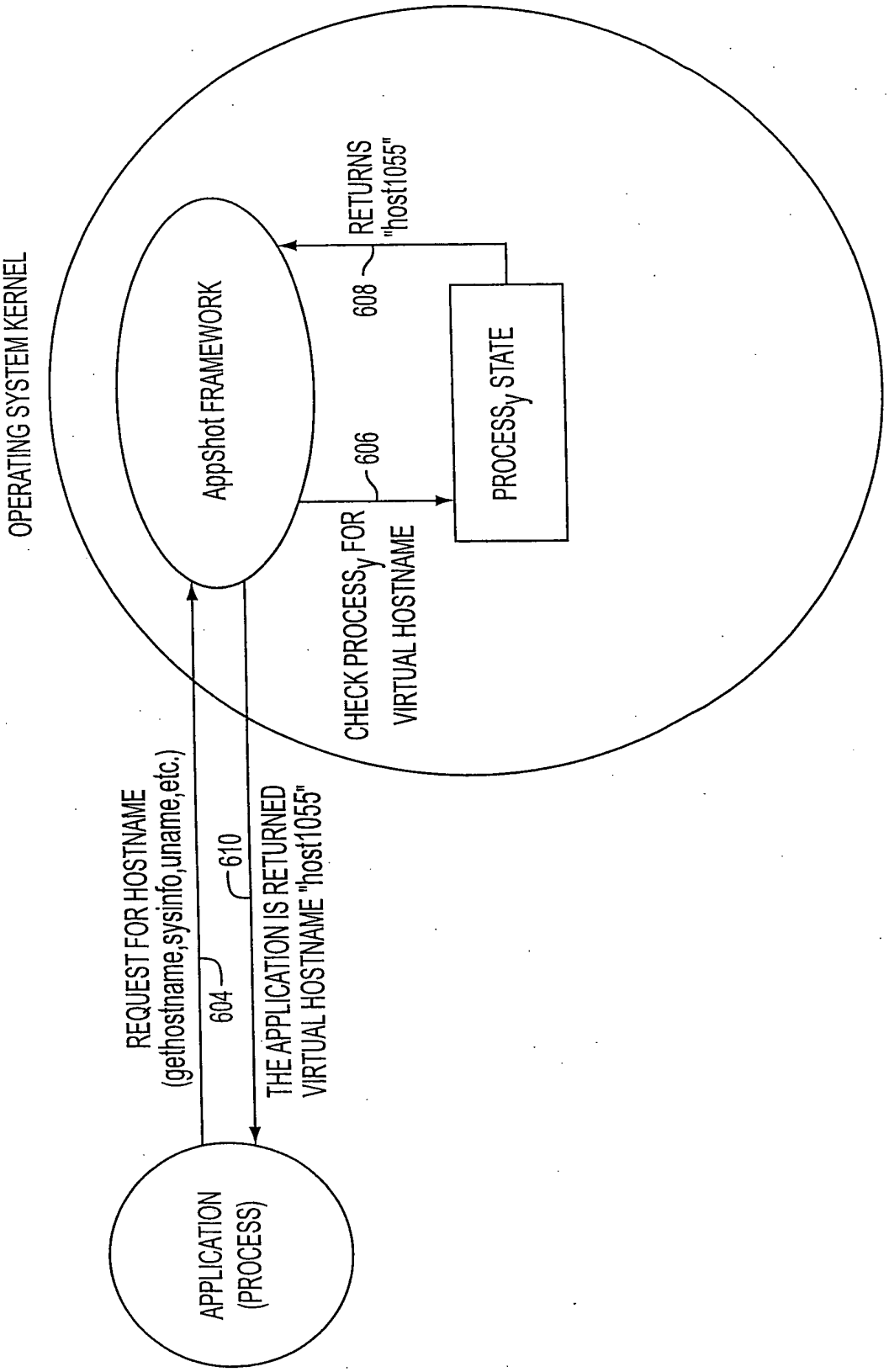

OPERATING SYSTEM KERNEL
AppShot FRAMEWORK
RETURNS "host1055"
608
606
PROCESS$_y$ STATE
CHECK PROCESS$_y$ FOR VIRTUAL HOSTNAME
REQUEST FOR HOSTNAME (gethostname,sysinfo,uname,etc.)
604
610
THE APPLICATION IS RETURNED VIRTUAL HOSTNAME "host1055"
APPLICATION (PROCESS)

FIG. 16

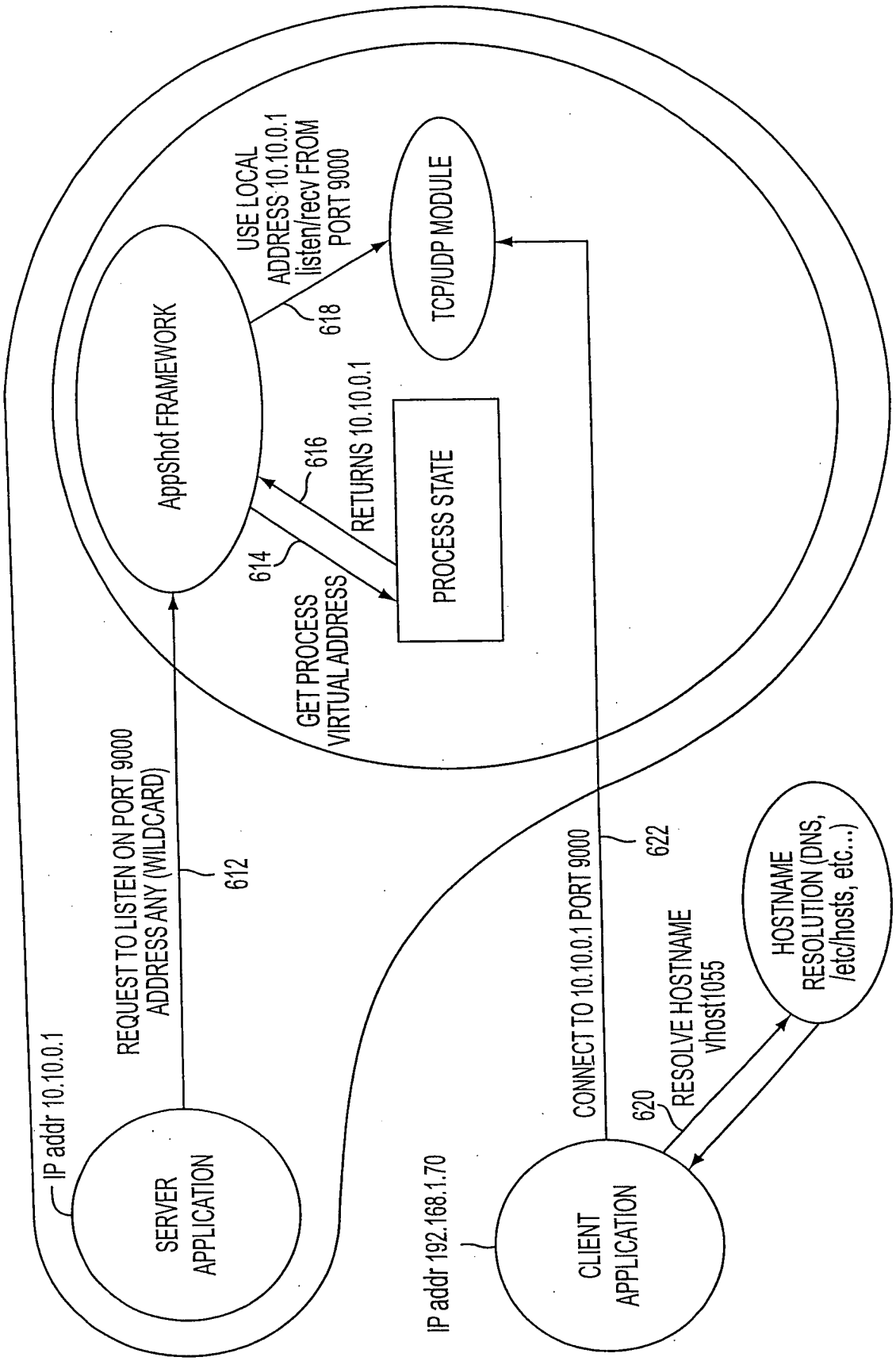

IP addr 10.10.0.1
SERVER APPLICATION
REQUEST TO LISTEN ON PORT 9000
ADDRESS ANY (WILDCARD)
612
AppShot FRAMEWORK
USE LOCAL
ADDRESS 10.10.0.1
listen/recv FROM
PORT 9000
618
TCP/UDP MODULE
616
RETURNS 10.10.0.1
614
GET PROCESS
VIRTUAL ADDRESS
PROCESS STATE
IP addr 192.168.1.70
CLIENT APPLICATION
CONNECT TO 10.10.0.1 PORT 9000
622
620
RESOLVE HOSTNAME
vhost1055
HOSTNAME
RESOLUTION (DNS,
/etc/hosts, etc...)

FIG. 17

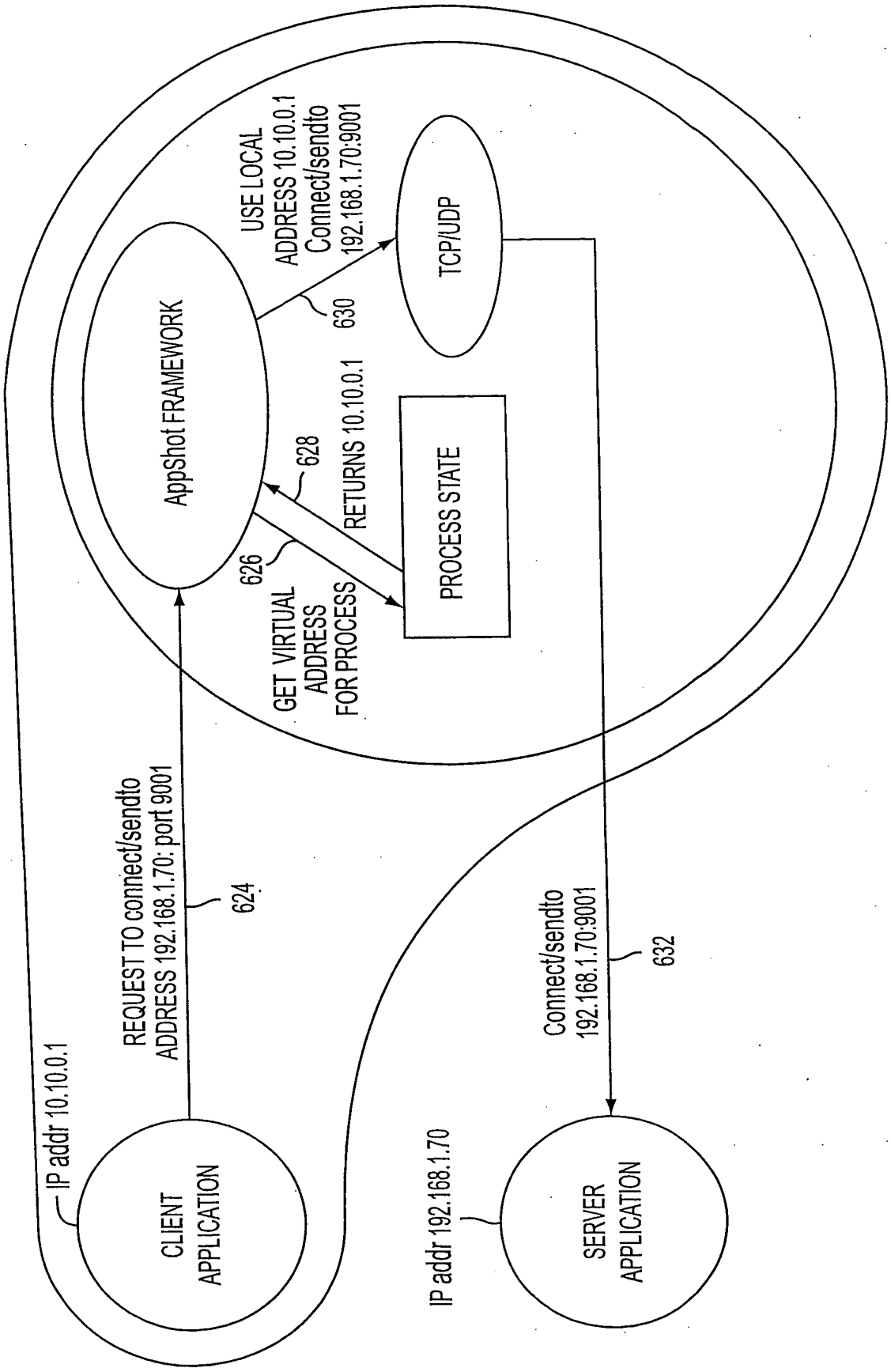

IP addr 10.10.0.1
CLIENT APPLICATION
REQUEST TO connect/sendto ADDRESS 192.168.1.70: port 9001
624
AppShot FRAMEWORK
626
GET VIRTUAL ADDRESS FOR PROCESS
628
RETURNS 10.10.0.1
PROCESS STATE
USE LOCAL ADDRESS 10.10.0.1 Connect/sendto 192.168.1.70:9001
630
TCP/UDP
IP addr 192.168.1.70
SERVER APPLICATION
Connect/sendto 192.168.1.70:9001
632

FIG. 18